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## *The* WHEAT STRAWWORM *and* ITS CONTROL



**T**HE WHEAT STRAWWORM is distributed throughout the principal wheat-growing regions of the United States and ranks high in importance as an insect enemy of wheat, often destroying whole fields of spring wheat.

Two complete generations occur each year. The first generation kills outright each tiller of wheat that it infests. The second generation causes considerable loss in yield to winter wheat and kills outright the tillers of spring wheat it attacks.

Several parasites and predacious enemies of this pest aid greatly in preventing continued losses, but cannot be relied upon for complete and effective control.

The wheat strawworm attacks wheat only, and the first generation, or spring form, is wingless and is unable to travel great distances. It can, therefore, be controlled if wheat is planted as much as 65 to 75 yards from any wheat straw or stubble of the previous season. In addition to this, in the regions where spring wheat is grown, all volunteer wheat should be destroyed when this pest is abundant, to prevent reinfestation from this source.

# THE WHEAT STRAWWORM AND ITS CONTROL

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## CONTENTS

	Page		Page
Economic importance.....	1	Life history.....	5
Wheat the only food plant.....	1	Natural enemies.....	8
Distribution.....	1	Control measures.....	9
Character of injury.....	2		

## ECONOMIC IMPORTANCE

THROUGHOUT the wheat-growing States east of the Mississippi River the annual depredations of the wheat strawworm (*Harmolita grandis* Riley) are ordinarily exceeded only by those of the hessian fly (*Phytophaga destructor* Say) and the wheat jointworm (*H. tritici* Fitch) and in certain areas it often exceeds either or both in destructiveness. In other wheat-growing regions also it is an important pest.

This insect occasions losses ranging from slight injury to total destruction of the crop, depending upon its abundance. A serious outbreak of the wheat strawworm was recorded from the whole State of Kansas during 1929, when entomologists of that State conservatively estimated a loss of between 10,000,000 and 15,000,000 bushels on account of this insect. This species is usually present in considerable numbers, and its populations seem able to increase rapidly. Even when it is very abundant and destructive, its presence may be readily overlooked, and the damage that it does may be ascribed to other causes. Therefore, in order to repress this pest, control measures should receive constant attention.

## WHEAT THE ONLY FOOD PLANT

Unlike many important insect pests, the wheat strawworm apparently has only one food plant, namely, wheat. It has been observed to lay eggs in several other plants, such as barley, oats, rye, and several grasses, but in such cases the resulting larvae or grubs were unable to complete their development. This greatly simplifies the problem of its control.

## DISTRIBUTION

The wheat strawworm undoubtedly occurs throughout the regions of the United States where wheat is grown regularly from year to

<sup>1</sup> Retired Dec. 31, 1934.

year. The accompanying map (fig. 1) indicates the States from which it has been reliably recorded by various observers. There are a number of States from which no records of its occurrence are available, but this insect probably occurs wherever wheat is grown to any extent.

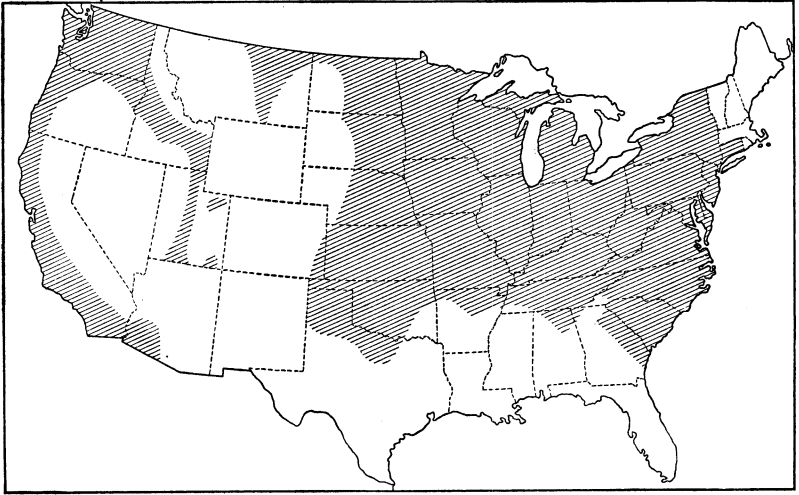


FIGURE 1.—Map showing the distribution of the wheat strawworm. The shaded area indicates the States from which occurrence has been reported.

#### CHARACTER OF INJURY

The wheat strawworm has two generations each year. The first generation is called the spring form (*Harmolita grandis*, form *minuta*) (fig. 2), and the second generation is called the summer form (*H. grandis*, form *grandis*) (fig. 3). Early in the spring the adult or parent insect of the first generation, or spring form, deposits its eggs in or near the embryonic wheat head (fig. 4) when the young wheat plants extend only a few inches above the surface of the ground. The larva or grub develops within and near the base of the plant, subsequently destroying the tiller or the entire plant where this plant has not previously tilled. Thus all tillers infested by the spring form of this pest are prevented from producing any grain and become a total loss. The results of this injury are apparent in figure 5, *A*, which shows the margin of a wheatfield that was very badly infested by the spring form. Figure 5, *B*, a photograph taken on the same date, shows plants about 60 yards from the infested margin of the field shown in *A*. Note that the plants in *B* are in full head, as contrasted with those in *A*.

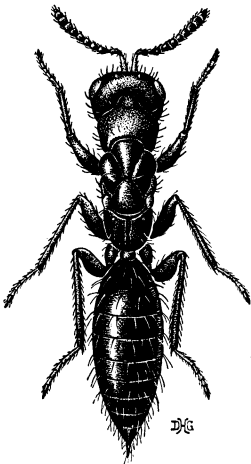


FIGURE 2.—Wheat strawworm: Wingless adult female of spring form; 17 times natural size. (After Knowlton.)

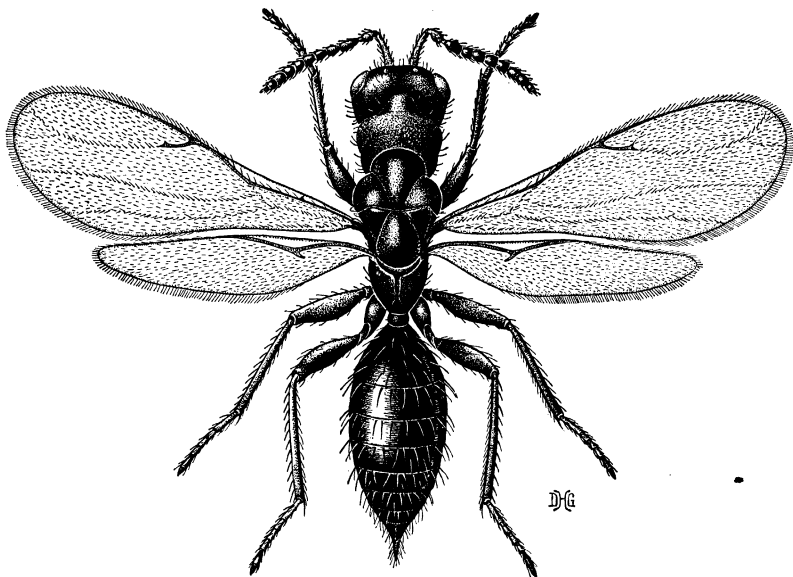


FIGURE 3.—Wheat strawworm: Adult female of summer form; 17 times natural size. (After Knowlton.)

The infested tillers resemble those infested with the hessian fly in that the central shoots do not develop and the leaves have the same characteristic dark-green color. As the larva, or grub, completes its development, the tiller usually becomes bulblike at the point of infestation (figs. 6 and 7), where the larva occupies a cavity which it has eaten out in the embryonic head. Later it transforms to the resting stage, from which adults of the second generation emerge.

The injury to wheat caused by the second generation, or summer form, is not so severe as that caused by the spring form, except where spring wheat is attacked, when the injury and loss are similar to that caused by the spring form in winter wheat, as previously described. The summer form deposits its eggs in winter wheat just above the youngest and most succulent joints, usually after the plant has headed and is in bloom. The larva sucks the juice of the tender plant and develops rapidly in the center of the stem (fig. 8), or sometimes in the walls of the stem before the straw has hardened. The stems of winter wheat are not killed and in fact show no external evidence of injury, but the effect produced by the insect is to reduce the

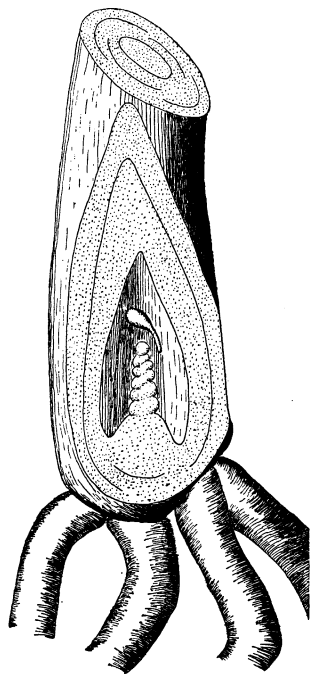


FIGURE 4.—Diagrammatic drawing of young wheat plant, showing embryonic wheat head near which the eggs of the spring form of the strawworm are deposited. Note the egg within the envelope that surrounds the tender head.



FIGURE 5.—*A*, Margin of a field showing wheat badly infested by the spring form of the wheat strawworm. *B*, Normal wheat uninfested by the wheat strawworm. Compare this wheat with the infested wheat 60 yards away, shown in *A*. The two photographs were taken on the same day.

yield of grain both in weight and in quality. This has been demonstrated clearly by collecting all the stems from a given area, separating the infested from the uninfested stems, and weighing the grain from each lot. Such weighings showed that the wheat strawworm caused an average loss of as much as 22 percent. When the

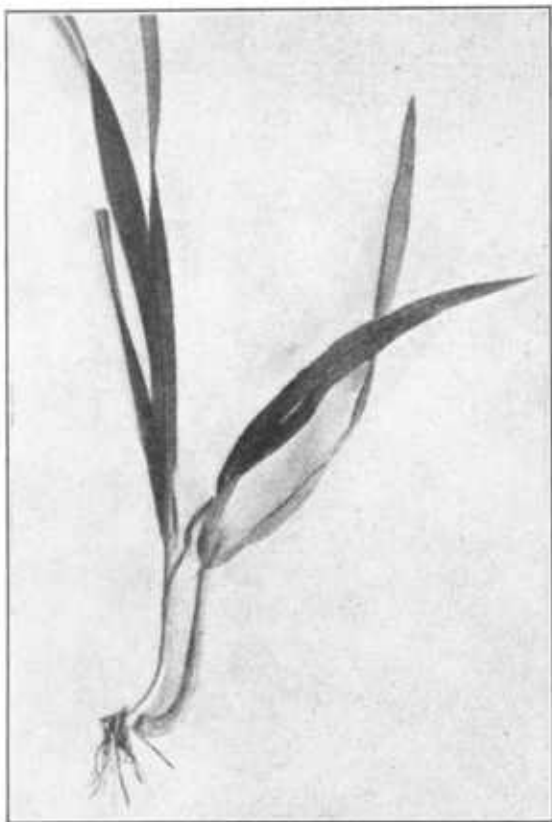


FIGURE 6.—Young wheat plant, with a healthy tiller, at the left; at the right, a tiller infested by the spring form of the wheat strawworm. Note the absence of the central shoot and the bulblike appearance of the infested culm near the base. About natural size.

yield of grain was estimated by weighing heads of the same size collected from infested and uninfested stems, the average loss was found to be 7 percent.

#### LIFE HISTORY

The two generations of the wheat strawworm are designated as the spring form and the summer form, respectively, because of the fact that even though these forms comprise individuals of the same species, they do not resemble each other very closely. Each of these forms passes through four stages of development, namely, the egg, the larva or grub, the pupa or resting stage, and the adult or parent insect.



The adults of the spring form (fig. 2) are minute, shiny black insects closely resembling ants, usually without wings. If wings are present, they are rarely fully developed. The legs have light-yellowish bands at the knees. This form of the insect passes the winter as a pupa (fig. 9) in the wheat stubble or straw of the previous season. The adults of the spring form, which are nearly all females, emerge in March and April in the Eastern and Central



FIGURE 7.—The same plant shown in figure 6 with the infested tiller split open to show the wheat strawworm in the cavity it has formed by eating the embryonic wheat head. About natural size.

States; in Washington State emergence occurs in April, and in Arizona it takes place during the latter part of January and continues through February. The females of this generation deposit their eggs in young wheat plants, in or very near the embryonic wheat head (fig. 4). The egg is white and nearly transparent, pear-shaped, and has a short, thick pedicel which is slightly curved. In about 10 days the larva hatches from the egg and totally destroys the embryonic head within the plant, usually causing a slight enlargement of the stem (figs. 6 and 7) at the point of infestation. The cavity thus formed in the crown of the plant is occupied by the

larva after it has completed its feeding. This larva becomes more robust than those of the summer form, perhaps because it feeds on the most nutritious part of the plant. It is of a light straw color, has brown jaws, and when full-grown is 0.17 inch long. Full growth is reached in about 27 days, and the pupa or resting stage (fig. 10) then begins. At first the pupa is the same color as the larva but later it changes to a shiny jet black. The pupal stage requires about 12 days, after which the fully developed adult of the summer form gnaws circular holes through the walls of the stem and comes out.



FIGURE 8.—Full-grown larva of summer form of the wheat strawworm in its cell in the center of the wheat stem.

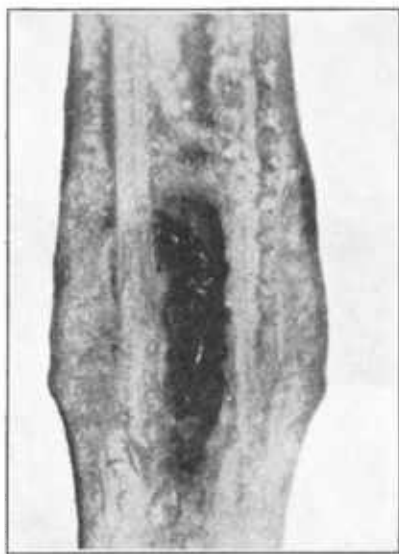


FIGURE 9.—Pupa from which emerges the adult of the spring form of the wheat strawworm in its cell in old wheat straw. Note how each end of the cell is plugged with frass. The winter is passed in this stage.

The adults of the summer form (fig. 3) are much larger and more vigorous than those of the spring form. They have fully developed wings which they use to great advantage in dispersing throughout fields adjacent to their place of development. Apparently they are strong flyers and with the aid of favorable winds have been found to fly to fields at considerable distances from where they originated.

No males have been found among the adults of the summer form, and the females reproduce without mating. They emerge in May and June in most of the wheat-growing regions and deposit eggs singly in the growing wheat plant slightly above the upper joints about the time the internodes between these joints begin to elongate rapidly. Winter wheat is heading at about this time. The two upper joints are usually preferred for oviposition, although every joint may be infested. Often the eggs are placed directly in the cavity of the stem or culm, but they may be placed in the walls of the stem. They hatch in from 5 to 5½ days. Normally only one larva is found at a joint. Where more than one larva is present one

may usually be found in the center of the stem, just above the joint, and the others in the walls. The larvae lacerate the inner walls of the stems, where they suck the rich plant juices and develop rapidly. They attain full growth before the plant tissues have hardened or else perish. The full-grown larvae of the summer form resemble in color those of the spring form, but are long and slender and not so robust. They form neat cells within or near the joints (fig. 8) and remain there to enter the pupal or resting stage (fig. 9) in the fall. No change occurs until early in the spring, when they develop into adults of the spring form and gnaw their way out, to continue their life cycle.

#### NATURAL ENEMIES

The wheat strawworm has a number of parasitic and predacious enemies but it is difficult to determine their relative efficiency because of the wide distribution of this pest. A predacious enemy of considerable importance is a very small mite, *Pediculoides ventricosus* Newp., which destroys the larva in the stem. This mite gains access to the larval cells that become ruptured during the process of harvesting and threshing. Unfortunately these predacious enemies do not confine themselves to the larva of the strawworm but devour the beneficial parasites as well as the host.



FIGURE 10.—Pupa from which emerges the adult of the summer form of the wheat strawworm in the tiller of a young plant where it developed.

Of the several parasites of the wheat strawworm, one of the most important is known scientifically as *Eupelmus allynii* French. As many as 22 percent of the wheat stems collected in Virginia as early as June 21, 1921, were found on dissection to be parasitized by this species. This parasite is a small, slender, four-winged wasp with a somewhat brilliant greenish-black body and yellow legs. In the southern half of the United States it has four or more generations each year.

Three important parasites of similar appearance, *Ditropinotus aureoviridis* Crawford, *Merisus febriculosus* Girault, and *Eridontomerus isosomatis* Crawford, have yellow abdomens and metallic-colored bodies. Each of these parasites has two or more generations each year.

Another important parasite, *Merisoporus chalcidiphagus* Walsh and Riley, has five generations each year in the southern half of the United States. This species in the adult stage is bluish black and in its life history is very similar to the parasites previously mentioned, except for the greater number of generations. Another parasite of potential importance, *Calosota metallica* Gahan, is restricted in its distribution to the Pacific coast and Rocky Mountain region. It seems to be widely distributed in California, where it has more than one generation annually.

All of the parasites mentioned are minute, four-winged wasps in the adult or parent stage and are of about the same size as the adult

of the strawworm. Unfortunately they cannot be depended upon, unassisted, to control the wheat strawworm.

#### CONTROL MEASURES

The parasites and predacious enemies of the wheat strawworm are important factors in preventing continued serious losses which this pest might cause. Without these enemies of this pest, growing wheat for profit would be difficult unless effective methods of control were practiced to some extent.

The first generation, or spring form, of this pest is practically wingless and cannot travel great distances to infest young wheat and thus continue the life cycle. Where wheat is planted adjoining wheat stubble or straw stacks of the previous season it has been found that the infestation caused by the spring form is greatest within 30 yards of the edge of the field bordering the old wheat straw. The writers have found, however, that the infestation at times may reach twice this distance, especially where the prevailing winds are favorable to the migration of the pest.

Where the wheat strawworm is troublesome an effective control, therefore, is to avoid growing wheat within 65 to 75 yards of wheat straw or stubble of the previous season, since this insect lives only on wheat.

In Virginia it has been found that wheat can safely follow wheat on the same land if all stubble is plowed under after harvest and the land sown to cowpeas, which in turn are disked into the soil in time for sowing the wheat in the fall.

In regions where spring wheat is grown to the exclusion of winter wheat, volunteer plants furnish the only places in which the adults of the spring or wingless form, developing from pupae overwintering in wheat straw or stubble of the previous year, can lay their eggs, the egg-laying period of this generation being finished before any spring-sown wheat is up. From these volunteer plants, therefore, if not destroyed, emerge the adults of the second generation, or winged form, which, laying their eggs in the spring wheat, may cause considerable loss to the crop.

In localities where the wheat strawworm is injurious, wheat should not be top-dressed with manure containing unrotted straw infested by this species.

Strawstacks are a greater source of infestation to growing wheat by the wheat strawworm than is usually supposed. In communities where this pest is very abundant, volunteer wheat around the strawstacks should be destroyed early in the spring before the first generation develops.

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